Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) ~~A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from the engine and the motor to a torque output shaft, the method comprising:~~

~~calculating angular acceleration of the motor;~~

~~calculating angular acceleration of the engine;~~

~~calculating moments of inertia of the motor and the generator;~~

~~calculating static gearing output torque and motor torque; and~~

~~estimating total wheel torque as a function of operating variables including inertia of both the motor and the generator, angular acceleration of the engine, motor torque and torque ratio from the motor to the vehicle wheels.~~

A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from the engine and the motor to a torque output shaft, the powertrain having a parallel operating mode in which the engine and the motor together solely define a power source and a non-parallel operating mode in which the engine, the generator and the motor solely define a power source, and a powertrain controller for controlling power distribution to vehicle traction wheels; the method comprising:

measuring values for motor speed, generator speed, engine speed, motor torque, generator torque, engine torque and storing these values in the controller;

calculating an angular acceleration for the motor;

calculating an angular acceleration for the engine;

determining whether the powertrain is operating in the parallel operating mode or in the non-parallel operating mode;

calculating a combined moment of inertia for the motor and a gearing element to which it is connected;

calculating a combined moment of inertia for the generator and a gearing element to which it is connected;

calculating a combined moment of inertia for the engine and a gearing element to which it is connected;

calculating torque ratio of gearing between the generator and the motor;

calculating torque ratio of gearing between the engine and the motor;

calculating torque ratio of gearing between the motor and vehicle traction wheels;

calculating static gearing output torque at the motor when the powertrain is in the parallel operating mode as a function of torque ratio of gearing between the engine and the motor, engine torque, the combined moment of inertia of the engine and a gearing element to which it is connected, and angular acceleration of the engine;

calculating static gearing output torque at the motor when the powertrain is in a non-parallel operating mode as a function of torque ratio of gearing between the generator and the motor and generator torque; and

estimating total wheel torque as a function of torque ratio of gearing between the motor and the traction wheels, torque of the motor, static gearing output torque, combined moment of inertia of the generator and a gearing element to which it is connected, angular acceleration of the engine, the sum of

the combined moment of inertia of the motor and a gearing element to which it is connected and the combined moment of inertia of the generator and a gearing element to which it is connected and engine angular acceleration;

whereby total output torque at the traction wheels for given operating conditions is estimated to permit control of traction wheel torque and ensure that actual powertrain output torque corresponds to a torque command by the controller.

2. (Withdrawn) A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain with a parallel operating mode, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from the engine and the motor to a torque output shaft, the method comprising:

calculating angular acceleration of the motor;

calculating angular acceleration of the engine;

calculating moments of inertia of the motor, the engine and the generator;

calculating static gearing output torque and motor torque; and

estimating total wheel torque as a function of operating variables including inertia of both the motor and the generator, angular acceleration of the engine, motor torque and torque ratio from the motor to the vehicle wheels.

3. (Withdrawn) A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain with a non-parallel operating mode, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from the engine and the motor to vehicle wheels, the method comprising:

calculating angular acceleration of the motor;

calculating angular acceleration of the engine;

calculating moments of inertia of the motor and the generator;

calculating static gearing output torque and motor torque during operation in the non-parallel mode as a function of torque ratio from the generator to the motor and generator torque; and

estimating total wheel torque as a function of operating variables including inertia of both the motor and the generator, angular acceleration of the engine, motor torque and torque ratio from the motor to the vehicle wheels.

4. (Withdrawn) A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain with non-parallel and parallel operating modes, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from the engine and the motor to vehicle wheels, the method comprising:

calculating angular acceleration of the motor;

calculating angular acceleration of the engine;

calculating moments of inertia of the motor, the engine and the generator; and

calculating static gearing output torque during operation in the parallel mode as a function of operating variables including torque ratio from the generator to the motor, engine torque, engine moment of inertia and engine angular acceleration.

5. (Currently Amended) The method set forth in claim 1 wherein estimated total wheel torque is computed in accordance with the equation:

$$\tau_{total\_wheel}=T_{mot2wheel}*(\tau_{mot}-\tau_{p@mot}+J_{gen\_couple}*dot\omega_{eng}-J_{mot\_eff}*dot\omega_{eng})$$

where:

τ_{total_wheel} = total wheel torque estimate;

$T_{mot2wheel}$ = torque ratio from motor to wheels;

$\tau_{p@mot}$ = torque @ motor shaft;

J_{gen_couple} = ~~coupled~~ combined moment of inertia of generator and the gear element to which it is connected;

$dot\omega_{eng}$ = engine angular acceleration;

J_{mot_eff} = sum of the ~~lumped~~ motor and gearing inertia and the ~~lumped~~ generator inertia reflected at the motor; and

τ_{mot} = motor torque.

6. (Withdrawn) The method set forth in claim 2 wherein estimated total wheel torque is computed in accordance with the equation:

$$\tau_{total\_wheel}=T_{mot2wheel}*(\tau_{mot}-\tau_{p@mot}+J_{gen\_couple}*dot\omega_{eng}-J_{mot\_eff}*dot\omega_{eng})$$

where:

τ_{total_wheel} = total wheel torque estimate;

$T_{mot2wheel}$ = torque ratio from motor to wheels;

$\tau_{p@mot}$ = torque @ motor shaft;

J_{gen_couple} = coupled moment of inertia of generator and the gear element to which it is connected;

$dot\omega_{eng}$ = engine angular acceleration;

J_{mot_eff} = sum of the lumped motor and gearing inertia and the lumped generator inertia reflected at the motor; and

τ_{mot} = motor torque.

7. (Withdrawn) The method set forth in claim 3 wherein estimated total wheel torque is computed in accordance with the equation:

$$\tau_{total\_wheel}=T_{mot2wheel}*(\tau_{mot}-\tau_{p@mot}+J_{gen\_couple}*dot\omega_{eng}-J_{mot\_eff}*dot\omega_{eng})$$

where:

τ_{total_wheel} = total wheel torque estimate;

$T_{mot2wheel}$ = torque ratio from motor to wheels;

$\tau_{p@mot}$ = torque @ motor shaft;

J_{gen_couple} = coupled moment of inertia of generator and the gear element to which it is connected;

$dot\omega_{eng}$ = engine angular acceleration;

J_{mot_eff} = sum of the lumped motor and gearing inertia and the lumped generator inertia reflected at the motor; and

τ_{mot} = motor torque.

8. (Withdrawn) The method set forth in claim 3 wherein static gearing output torque is computed in accordance with the equation:

$$\tau_{p@mot}=T_{gen2mot}*\tau_{gen}$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{gen2mot}$ = torque ratio from generator to motor shaft; and

τ_{gen} = generator torque.

9. (Withdrawn) The method set forth in claim 4 wherein static gearing output torque is computed in accordance with the equation:

$$\tau_{p@mot}= -T_{gen2mot}*(\tau_{eng}-J_{eng}*dot\omega_{eng})$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{gen2mot}$ = torque ratio from engine to motor shaft;

τ_{eng} = engine torque;

J_{eng} = lumped moment of inertia of engine and the element of the gearing to which it is connected; and

$dot\omega_{eng}$ = engine angular acceleration.

10. (Withdrawn) The method set forth in claim 4 wherein estimated total wheel torque is computed in accordance with the equation:

$$\tau_{total\_wheel}=T_{mot2wheel}*(\tau_{mot}-\tau_{p@mot}+J_{gen\_couple}*dot\omega_{eng}-J_{mot\_eff}*dot\omega_{eng})$$

where:

τ_{total_wheel} = total wheel torque estimate;

$T_{mot2wheel}$ = torque ratio from motor to wheels;

$\tau_{p@mot}$ = torque @ motor shaft;

J_{gen_couple} = coupled moment of inertia of generator and the gear element to which it is connected;

$dot\omega_{eng}$ = engine angular acceleration;

J_{mot_eff} = sum of the lumped motor and gearing inertia and the lumped generator inertia reflected at the motor; and

τ_{mot} = motor torque.

11. (Currently Amended) The method set forth in claim 1 wherein static gearing output torque is computed <u>during operation in the non-parallel mode</u> in accordance with the equation:

$$\tau_{p@mot}=T_{gen2mot}*\tau_{gen}$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{gen2mot}$ = torque ratio from generator to motor shaft; and

τ_{gen} = generator torque.

12. (Withdrawn) The method set forth in claim 2 wherein static gearing output torque is computed in accordance with the equation:

$$\tau_{p@mot}=T_{gen2mot}*\tau_{gen}$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{gen2mot}$ = torque ratio from generator to motor shaft; and

τ_{gen} = generator torque.

13. (New) The method set forth in claim 1 wherein static gearing output torque is computed during operation of the powertrain in the parallel operating mode in accordance with the equation:

$$\tau_{p@mot}= -T_{eng2mot}*(\tau_{eng}-J_{eng}*dot\omega_{eng})$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{eng2mot}$ = torque ratio from engine to motor shaft;

τ_{eng} = engine torque;

J_{eng} = lumped moment of inertia of engine and the element of the gearing to which it is connected; and

$dot\omega_{eng}$ = engine angular acceleration.

14. (New) The method set forth in claim 1 wherein the step of determining whether the powertrain is operating in the parallel operating mode or in the non-parallel operating mode comprises:

verifying that the generator speed is less than a predetermined threshold speed value and that the generator torque is less than a predetermined threshold torque value; and

conditioning the controller for the non-parallel operating mode if the generator speed is less than a

predetermined threshold speed value and the generator torque is less than a predetermined threshold torque value.

15. (New) The method set forth in claim 1 wherein the step of determining whether the powertrain is operating in the parallel operating mode or in the non-parallel operating mode comprises:

verifying that the generator speed is greater than or equal to a predetermined threshold speed value and that the generator torque is greater than or equal to a predetermined threshold torque value; and

conditioning the controller for the parallel operating mode if the generator speed is greater than or equal to a predetermined threshold speed value and the generator torque is greater than or equal to a threshold torque value.

16. (New) A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from the engine and the motor to a torque output shaft, the powertrain having a parallel operating mode in which the engine and the motor together solely define a power source and a non-parallel operating mode in which the engine, the generator and the motor solely define a power source, and a powertrain controller for controlling power distribution to vehicle traction wheels; the method comprising:

measuring values for motor speed, generator speed, engine speed, motor torque, generator torque, engine torque and storing these values in the controller;

calculating an angular acceleration for the motor;

calculating an angular acceleration for the engine;

determining whether the powertrain is operating in the parallel operating mode or in the non-parallel operating mode;

calculating a combined moment of inertia for the motor and a gearing element to which it is connected;

calculating a combined moment of inertia for the generator and a gearing element to which it is connected;

calculating a combined moment of inertia for the engine and a gearing element to which it is connected;

calculating torque ratio of gearing between the generator and the motor;

calculating torque ratio of gearing between the engine and the motor;

calculating torque ratio of gearing between the motor and vehicle traction wheels;

calculating static gearing output torque at the motor when the powertrain is in a non-parallel operating mode as a function of torque ratio of gearing between the generator and the motor and generator torque; and

estimating total wheel torque as a function of torque ratio of gearing between the motor and the traction wheels, torque of the motor, static gearing output torque, combined moment of inertia of the generator and a gearing element to which it is connected, angular acceleration of the engine, the sum of the combined moment of inertia of the motor and a gearing element to which it is connected and the combined moment of inertia of the generator and a gearing element to which it is connected and engine angular acceleration;

whereby total output torque at the traction wheels for given operating conditions is estimated to permit control of traction wheel torque and ensure that actual powertrain output torque corresponds to a torque command by the controller.

17. (New) A method for determining driving wheel torque for a vehicle having a hybrid electric powertrain, the powertrain comprising an engine, an electric motor, a battery, a generator and gearing that define plural torque flow paths from

the engine and the motor to a torque output shaft, the powertrain having a parallel operating mode in which the engine and the motor together solely define a power source and a non-parallel operating mode in which the engine, the generator and the motor solely define a power source, and a powertrain controller for controlling power distribution to vehicle traction wheels; the method comprising:

measuring values for motor speed, generator speed, engine speed, motor torque, generator torque, engine torque and storing these values in the controller;

calculating an angular acceleration for the motor;

calculating an angular acceleration for the engine;

determining whether the powertrain is operating in the parallel operating mode or in the non-parallel operating mode;

calculating a combined moment of inertia for the motor and a gearing element to which it is connected;

calculating a combined moment of inertia for the generator and a gearing element to which it is connected;

calculating a combined moment of inertia for the engine and a gearing element to which it is connected;

calculating torque ratio of gearing between the generator and the motor;

calculating torque ratio of gearing between the engine and the motor;

calculating torque ratio of gearing between the motor and vehicle traction wheels;

calculating static gearing output torque at the motor when the powertrain is in the parallel operating mode as a function of torque ratio of gearing between the engine and the motor, engine torque, the combined moment of inertia of the engine and a gearing element to which it is connected, and angular acceleration of the engine;

estimating total wheel torque as a function of torque ratio of gearing between the motor and the traction wheels,

torque of the motor, static gearing output torque, combined moment of inertia of the generator and a gearing element to which it is connected, angular acceleration of the engine, the sum of the combined moment of inertia of the motor and a gearing element to which it is connected and the combined moment of inertia of the generator and a gearing element to which it is connected and engine angular acceleration;

whereby total output torque at the traction wheels for given operating conditions is estimated to permit control of traction wheel torque and ensure that actual powertrain output torque corresponds to a torque command by the controller.

18. (New) The method set forth in claim 16 wherein static gearing output torque is computed in accordance with the equation:

$$\tau_{p@mot}=T_{gen2mot}*\tau_{gen}$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{gen2mot}$ = torque ratio from generator to motor shaft; and

τ_{gen} = generator torque.

19. (New) The method set forth in claim 17 wherein static gearing output torque is computed in accordance with the equation:

$$\tau_{p@mot}= -T_{eng2mot}*(\tau_{eng}-J_{eng}*dot\omega_{eng})$$

where:

$\tau_{p@mot}$ = torque at motor shaft;

$T_{eng2mot}$ = torque ratio from engine to motor shaft;

τ_{eng} = engine torque;

J_{eng} = combined moment of inertia of engine and the element of the gearing to which it is connected; and

$\dot{\omega}_{eng}$ = engine angular acceleration.